CLAIMS

1. An atomic layer deposition method, comprising:

positioning a semiconductor substrate within an atomic layer deposition chamber;

feeding a first deposition precursor to the chamber under first vacuum conditions effective to form a first monolayer on the substrate, the first vacuum conditions being maintained at least in part by a first non-roughing vacuum pump connected to the chamber and through which at least some of the first deposition precursor flows; and

after forming the first monolayer, feeding a purge gas to the chamber under second vacuum conditions maintained at least in part by a second non-roughing vacuum pump connected to the chamber which is different from the first non-roughing vacuum pump and through which at least some of the purge gas flows.

2. The method of claim 1 comprising using a roughing vacuum pump to lower chamber pressure prior to the first deposition precursor feeding.

3. The method of claim 1 comprising after feeding the purge gas, feeding a second deposition precursor different from the first deposition precursor to the chamber effective to form a second monolayer on the first monolayer.

4. The method of claim 1 comprising after feeding the purge gas, feeding a second deposition precursor to the chamber different from the first deposition precursor under third vacuum conditions effective to form a second monolayer on the first monolayer and using the first non-roughing vacuum pump in fluid communication with the chamber during the second deposition precursor feeding.

5. The method of claim 1 comprising after feeding the purge gas, feeding a second deposition precursor to the chamber different from the first deposition precursor under third vacuum conditions effective to form a second monolayer on the first monolayer, the third vacuum conditions being maintained at least in part by a third non-roughing vacuum pump connected to the chamber which is different from the first and second non-roughing vacuum pumps.

6. The method of claim 1 wherein the first vacuum conditions include a substantially constant vacuum pressure within the chamber.

7. The method of claim 1 wherein the first vacuum conditions include varied vacuum pressure within the chamber.

8. The method of claim 1 wherein vacuum pressure within the chamber is substantially the same under the first and second vacuum conditions.

9. The method of claim 1 wherein vacuum pressure within the chamber is substantially constant and the same under the first and second vacuum conditions.

10. The method of claim 1 wherein vacuum pressure within the chamber is different under the first and second vacuum conditions.

11. The method of claim 1 wherein vacuum pressure within the chamber is substantially constant and different under the first and second vacuum conditions.

12. The method of claim 1 comprising isolating the first non-roughing vacuum pump from the chamber during at least some of the purge gas feeding.

13. The method of claim 1 comprising isolating the second non-roughing vacuum pump from the chamber during at least some of the first deposition precursor feeding.

14. The method of claim 1 comprising isolating the second non-roughing vacuum pump from the chamber during all of the first deposition precursor feeding.

15. The method of claim 1 comprising operating the second non-roughing vacuum pump at a higher pumping speed during the purge gas feeding than the first non-roughing vacuum pump is operated at during the first deposition precursor feeding.

16. The method of claim 1 wherein the chamber is provided with multiple outlets at the chamber, one of said outlets being in fluid communication with the first non-roughing vacuum pump, another of said outlets being in fluid communication with the second non-roughing vacuum pump.

17. The method of claim 1 wherein the chamber is provided with one outlet at the chamber which is in fluid communication with both the first and second non-roughing vacuum pumps.

18. An atomic layer deposition method, comprising:

positioning a semiconductor substrate within an atomic layer deposition chamber;

feeding a first deposition precursor to the chamber under first vacuum conditions effective to form a first monolayer on the substrate, the first vacuum conditions being maintained at least in part by a first non-roughing vacuum pump connected to the chamber and through which at least some of the first deposition precursor flows, the first non-roughing vacuum pump being operated at a first substantially constant pumping speed while forming the first monolayer; and

after forming the first monolayer, isolating the first non-roughing vacuum pump from the chamber and feeding a purge gas to the chamber under second vacuum conditions maintained at least in part by a second non-roughing vacuum pump connected to the chamber which is different from the first non-roughing vacuum pump and through which at least some of the purge gas flows, the second non-roughing vacuum pump being operated at a second pumping speed which is greater than the first pumping speed.

19. The method of claim 18 wherein the isolating occurs during the purge gas feeding.

20. The method of claim 18 wherein the isolating occurs before the purge gas feeding.

21. The method of claim 18 comprising isolating the second non-roughing vacuum pump from the chamber during at least some of the first deposition precursor feeding.

22. The method of claim 18 comprising isolating the second non-roughing vacuum pump from the chamber during all of the first deposition precursor feeding.

23. The method of claim 18 comprising after feeding the purge gas, feeding a second deposition precursor different from the first deposition precursor to the chamber effective to form a second monolayer on the first monolayer.

24. The method of claim 18 comprising after feeding the purge gas, feeding a second deposition precursor to the chamber different from the first deposition precursor under third vacuum conditions effective to form a second monolayer on the first monolayer and using the first non-roughing vacuum pump in fluid communication with the chamber during the second deposition precursor feeding.

25. The method of claim 18 comprising after feeding the purge gas, feeding a second deposition precursor to the chamber different from the first deposition precursor under third vacuum conditions effective to form a second monolayer on the first monolayer, the third vacuum conditions being maintained at least in part by a third non-roughing vacuum pump connected to the chamber which is different from the first and second non-roughing vacuum pumps.

26. The method of claim 18 wherein vacuum pressure within the chamber is different under the first and second vacuum conditions.

27. An atomic layer deposition apparatus, comprising:

an atomic layer deposition chamber having a substrate passageway communicating to externally of the chamber;

a first non-roughing vacuum pump in fluid communication with the chamber apart from the substrate passageway; and

a second non-roughing vacuum pump in fluid communication with the chamber apart from the substrate passageway.

28. The apparatus of claim 27 comprising a third non-roughing vacuum pump in fluid communication with the chamber apart from the substrate passageway.

29. The apparatus of claim 27 comprising a load chamber in fluid communication with the atomic layer deposition chamber through the substrate passageway, and a load chamber vacuum pump in fluid communication with the load chamber apart from the substrate passageway.

30. The apparatus of claim 27 wherein the first non-roughing vacuum pump is configured for feeding a deposition precursor to the chamber and the second non-roughing vacuum pump is configured for feeding a purge gas to the chamber.

31. The apparatus of claim 27 wherein the first and second non-roughing vacuum pumps have different rated throughputs over a given operating pressure range.

32. The apparatus of claim 31 wherein the first non-roughing vacuum pump is configured for feeding a deposition precursor to the chamber and the second non-roughing vacuum pump is configured for feeding a purge gas to the chamber, the second non-roughing vacuum pump having a higher rated throughput than the first non-roughing vacuum pump over the given operating pressure range.

33. The apparatus of claim 27 wherein the first and second non-roughing vacuum pumps have common rated throughputs over a given operating pressure range.

34. The apparatus of claim 27 wherein the first and second non-roughing vacuum pumps are configured for operating at variable speeds over a given operating pressure range.

35. The apparatus of claim 27 wherein the first and second non-roughing vacuum pumps are configured for operating at respective constant speeds over a given operating pressure range.

36. The apparatus of claim 27 wherein one of the first and second non-roughing vacuum pumps is configured for operating at a constant speed over a given operating pressure range, and the other of the first and second non-roughing vacuum pumps is configured for operating at variable speeds over a given operating pressure range.

37. The apparatus of claim 27 comprising a roughing vacuum pump in fluid communication with the chamber apart from the substrate passageway.

38. The apparatus of claim 27 wherein the chamber is provided with multiple outlets at the chamber, one of said outlets being in fluid communication with the first non-roughing vacuum pump, another of said outlets being in fluid communication with the second non-roughing vacuum pump.

39. The apparatus of claim 27 wherein the chamber is provided with one outlet at the chamber which is in fluid communication with both the first and second non-roughing vacuum pumps.

40. The apparatus of claim 39 comprising:

a conduit extending from the one outlet, the first and second non-roughing vacuum pumps being in fluid communication with the conduit; and

at least one first pump and second pump isolation valve.

41. The apparatus of claim 39 comprising:

a conduit extending from the one outlet, the first and second non-roughing vacuum pumps being in fluid communication with the conduit; and

one and only one first pump and second pump isolation valve.

42. The apparatus of claim 39 comprising:

a conduit extending from the one outlet, the first and second non-roughing vacuum pumps being in fluid communication with the conduit; and

a pivotable flap valve received within the conduit configured for selectively isolating the first and second pumps from fluid communication with the conduit.

43. The apparatus of claim 39 comprising:

a conduit extending from the one outlet, the first and second non-roughing vacuum pumps being in fluid communication with the conduit; and

a rotatable valve received within the conduit configured for selectively isolating the first and second pumps from fluid communication with the conduit.

44. The apparatus of claim 39 comprising:

a conduit extending from the one outlet, the first and second non-roughing vacuum pumps being in fluid communication with the conduit; and

a slidable valve received within the conduit configured for selectively isolating the first and second pumps from fluid communication with the conduit.

45. An atomic layer deposition apparatus, comprising:

an atomic layer deposition chamber having a substrate passageway communicating to externally of the chamber;

a first non-roughing vacuum pump in fluid communication with the chamber apart from the substrate passageway, the first non-roughing vacuum pump being configured with the chamber for feeding a first deposition precursor to the chamber;

a second non-roughing vacuum pump in fluid communication with the chamber apart from the substrate passageway, the second non-roughing vacuum pump being configured with the chamber for feeding a purge gas to the chamber; and

a third non-roughing vacuum pump in fluid communication with the chamber apart from the substrate passageway, the third non-roughing vacuum pump being configured with the chamber for feeding a second deposition precursor to the chamber.

46. The apparatus of claim 45 comprising a load chamber in fluid communication with the atomic layer deposition chamber through the substrate passageway, and a load chamber vacuum pump in fluid communication with the load chamber apart from the substrate passageway.

47. The apparatus of claim 45 comprising a roughing vacuum pump in fluid communication with the chamber apart from the substrate passageway.

48. The apparatus of claim 45 wherein the first and third non-roughing vacuum pumps have different rated throughputs over a given operating pressure range as compared to the second non-roughing vacuum pump.

49. The apparatus of claim 48 wherein the second non-roughing vacuum pump has a higher rated throughput than either of the first and second non-roughing vacuum pumps.

50. The apparatus of claim 45 wherein the first and third non-roughing vacuum pumps have a common rated throughput over a given operating pressure range and which is different as compared to the second non-roughing vacuum pump.

51. The apparatus of claim 50 wherein the second non-roughing vacuum pump has a higher rated throughput than that of the first and second non-roughing vacuum pumps.

52. The apparatus of claim 45 wherein the chamber is provided with multiple outlets at the chamber, one of said outlets being in fluid communication with the first non-roughing vacuum pump, another of said outlets being in fluid communication with the second non-roughing vacuum pump, still another of said outlets being in fluid communication with the third non-roughing vacuum pump.

53. The apparatus of claim 45 wherein the chamber is provided with one outlet at the chamber which is in fluid communication with each of the first, second and third non-roughing vacuum pumps.